Tanzania Journal of Science
Volume 51(3), 2025
journal homepage: https://commons.udsm.ac.tz/tjs/

Morphometric and meristic analysis of *Labeo coubie* in Esa-Odo water reservoir, Esa-Odo, Osun state Nigeria

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Keywords

L. coubie; Morphometric traits;
Condition factor;
Esa-Odo;
Stock assessment

Abstract

One of the common species of family Cyprinidae found in Nigeria and West Africa is *Labeo coubie*. They are of commercial importance in West Africa. This study embarked on the assessment of the length-weight relationship, condition factor, morphometrics and meristic characteristics of *L. coubie* from Esa-Odo water reservoir, Esa-Odo, Osun State Nigeria. A total of 135 (65 males and 70 females) individual *L. coubie* collected from fishermen were subjected to morphometric and meristic analysis. Results showed 4.90, 5.46 and 5.24 as the b value for male, female and combined sexes respectively, describing positive allometric growth for all the fish (male, female and combined sexes). The mean condition factors for male, female and combined sexes were 0.75 ± 0.01, 0.71 ± 0.02 and 0.72 ± 0.01 indicating suboptimal condition. The correlation coefficient (R) for male, female and combined sexes were 0.92, 0.91 and 0.92 respectively showing positive relationship between the weight and total length of the fish. All morphometric traits showed statistically significant positive correlation ($p \leq 0.05$) with total length. This study also elucidated a fin formular of *L. coubie* as D11, A6-7, P 12-15 and V8-9. This study presents base line information needed for sustainable exploitation, management and conservation of the fish (*L. coubie*).

Introduction

Among the members of the family Cyprinidae, genus *labeo* is commonly found in the rivers of Ivory Coast, Nigeria, Zaire, Senegal and Liberia within African water bodies (Ayotunde et al. 2007, Olufeagba et al. 2016). Among species of Labeo found in African rivers are *Labeo coubie, Labeo senegalensis, Labeo rhohita and Labeo pseudocoubie*. *Labeo coubie*, which is particularly common in Nigerian freshwater ecosystems has a record of length and weight of about 700mm and 10kg respectively (Idodo-umeh 2005, Ayotunde et al. 2007). *L. coubie* are found in fresh water inhabiting rivers and lakes, migrating within the water body, feeding on plant dendritus and diatoms (Azeroual et al. 2010). They are highly value food fish, very rich in protein, have pleasant taste and also show potentials as ornamental

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Received 3rd March 2025, Revised 11th June 2025, Accepted 25th August, 2025, Published 30th October 2025
https://doi.org/10.65085/2507-7961.1076

ISSN 0856-1761, e-ISSN 2507-7961

species (Ayotunde et al. 2007, Ajijola et al. 2022). Along the Southern and Northern banks of Benue River, *Labeo* species constituted 10.3% of total fish catch and 8% by weight of fish harvested from the water body (FAO 2017).

For the purpose of sustainable exploitation, estimation of population size of a fish stock is important and this requires the knowledge of relationship such as length-weight relationship (Lecren 1951, Froese 2006). This will enable comparative analysis across different species and populations, it will also serve as indicator of environmental changes and also provide knowledge of growth patterns of fish species. Length-weight relationship and condition factor is mostly estimated in fish biology, it is an important factor in fish biology for stock assessment (Sumbuloglu 2000, Mendes et al. 2004). Length-weight relationship is not limited to its basic use, it also has applied usage, from a predetermined length-weight relationship, a deduction of the live weight of a fish can be made from the available fish length or vice-versa (Bagenal and Tesch 1978, Pitcher and Hart 1982).

Length-weight relationship can be used to determine growth pattern of fish in culture system, estimate fish biomass, deduce fish condition and compare morphology of fish population from different regions (Petrakis and Stergion 1995, Stergion and Moutopoulos 2002). Relative wellbeing of fish is often assessed through condition factor (Kulbicki et al. 1993 and King 1996). Condition factor quantifies the deviation of a fish's actual weight from its ideal weight based on length (Dutta and Das 2014) by evaluating the weight relative to length, fish biologists can gain insight into the overall condition, nutritional status and ecological health of fish population.

Limited information is available on the fish species *L. coubie*, information on its stock assessment, length-weight relationships, condition factors, morphometrics and meristic characteristics are lacking (Ajijola et al. 2022). The aim of this study was to evaluate the length-weight relationship, condition factor, morphology and meristic characteristics of *L. coubie*. The study findings provide insights into the growth pattern of the fish, this information can be used to regulate the mesh size for sustainable harvest of the species.

Material and Methods

A total of 135 specimen of *L. coubie* were collected at landing site from fishermen at Esa-Odo water reservoir, Esa-Odo, Osun State, Nigeria for a period of three month (November, December, 2024 and January, 2025). Fish samples, *L. coubie* only were collected from total fish catch and transported in plastic holding tanks with ice packs. The samples were transported to the Laboratory of the Department of Biology, Faculty of Sciences, University of Ilesa, Ilesa, Osun State, Nigeria. Various morphological measurements of the fish samples were taken following the published procedure (Batubara et al. 2018, Fagbuaro et al. 2019). Length measurements were conducted using transparent ruler and measuring board to the nearest 0.1cm. Body weight measurement of the fish samples were conducted using an electric digital weighing scale ATOM, Model ATOM-A110C-Blue-600gm. Weight measurements were recorded to the nearest 0.1g. Measurements of twenty morphological parameters were examined for each fish sampled (Table 1). Meristic traits such as number of spines, fin rays, total scale on lateral line, scales above and below lateral line were recorded (Table 2). Estimation of length-weight relationship were done using the equation $W = aL^b$ (Pauly, 1984) where W = weight (g), L = total length (cm), a = regression constant or intercept b = regression coefficient or slope. The relationship was transformed into a linear form log W = a + blog L using Microsoft Excel to calculate “a” and “b” value. Sex of fish were determined by dissection and examination of gonads.

Condition factor $K = 100W/L^3$ for combined, females and male sexes were estimated using mean of total length and weight, K= condition factor, W= mean body weight (g) and L= mean total length (cm) Pauly (1983). Fish were dissected and gonads

examined to establish sex of fish samples. Microsoft Excel 2013 was used to evaluate the relationship between total length and weight of fish (males, females and combined sexes). Meristic count for characteristics such as fin ray, number of scales on lateral line, scale below and above lateral line were visually counted following the procedure of Batubara et al. (2018) and Fagbuaro et al. (2019) and recorded in tabular form.

Results

The mean of morphometric characteristics of male, female and both sexes of *L. coubie* are presented in Table 1. Based on the mean body weight presented in Table 1, females (42.22 g) were generally larger than males (31.69 g), while the combined sexes averaged 37.75 g. All linear body measurements including caudal fin length, dorsal fin length, anal fin base length, pectoral and pelvic fins, head length, and snout length followed the same trend as body weight, showing consistent sexual differences between males and females. Females exhibited deeper bodies (3.53 cm) and longer caudal peduncles (1.95 cm) compared with males (3.07 cm body depth; 1.73 cm caudal peduncle). Overall, sexual dimorphism was evident, as females consistently displayed higher morphometric values than males in nearly all traits, except eye diameter, which was nearly identical between the sexes (0.60 cm).

Table 1: Morphometric characteristics of *L. coubie* from Esa-Odo Water Reservoir

S/N	Characteristics	Male Mean ± SE (cm)	Female Mean ± SE (cm)	Combined sexes Mean ± SE (cm)
1.	Weight (g)	31.69 ± 3.31	42.22 ± 3.03	37.75 ± 2.39
2	Total Length	15.99 ± 0.62	17.95 ± 0.50	17.12 ± 0.42
3	Fork Length	4.16 ± 0.13	4.37 ± 0.09	4.28 ± 0.08
4	Standard Length	12.81 ± 0.53	14.37 ± 0.42	13.71 ± 0.35
5	Pelvic Fin Length	2.51 ± 0.08	2.60 ± 0.07	2.56 ± 0.05
6	Pectoral fin length	2.70 ± 0.07	2.89 ± 0.07	2.80 ± 0.05
7	Caudal fin length	3.50 ± 0.16	4.28 ± 0.10	4.07 ± 0.10
8	Pre-dorsal length	5.20 ± 0.21	5.94 ± 0.17	5.66 ± 0.14
9	Pre-anal length	10.60 ± 0.34	11.69 ± 0.33	11.17 ± 0.26
10	Pre-pectoral length	2.80 ± 0.10	3.11 ± 0.09	2.98 ± 0.07
11	Pre-pelvic length	6.40 ± 0.22	7.25 ± 0.20	6.93 ± 0.16
12	Length of Dorsal fin base	2.392 ± 0.10	2.75 ± 0.09	2.6 ± 0.08
13	Length of anal fin base	0.80 ± 0.04	1.06 ± 0.04	1.00 ± 0.03
14	Dorsal fin length	3.70 ± 0.25	4.45 ± 0.20	4.24 ± 0.16
15	Length of caudal peduncle	1.60 ± 0.07	1.93 ± 0.08	1.80 ± 0.06
16	Body Depth	3.07 ± 0.14	3.53 ± 0.11	3.33 ± 0.09
17	Snout Length	1.22 ± 0.05	1.38 ± 0.03	1.31 ± 0.03
18	Eye diameter	0.60 ± 0.01	0.6 ± 0.02	0.59 ± 0.01
19	Head Length	2.80 ± 0.12	3.23 ± 0.09	3.11 ± 0.08
20	Depth of Caudal Peduncle	1.73 ± 0.06	1.95 ± 0.06	1.86 ± 0.05

The meristic characteristics of *L. coubie* are represented in Table 2. Meristic traits of *L. coubie* presented in Table 2 show relatively stable fin ray counts in the dorsal fin (11), with greater variation observed in the pectoral (12–15), pelvic (8–9), anal (6–7), and caudal (20–21) fin rays, as well as in scale counts. No spines were recorded in the dorsal, anal, or pelvic fins, indicating that *L. coubie* from the reservoir lacks fin spination.

Table 2: Meristic characteristics of *L. coubie* from Esa-Odo Water Reservoir, Esa-Odo

S/N	Character	Number
1.	Dorsal spine	0
2.	Anal Spine	0

3.	Ventra/Pelvic fin spines	0
4.	Dorsal fin ray	11
5.	Anal fin ray	6–7
6.	Pectoral fin rays	12–15
7.	Ventral/Pelvic fin rays	8–9
8.	Caudal fin rays	20–21
9.	scales of lateral line	33–36
10.	Scales above lateral line	2.5–5.5
11	Scales below lateral line	2.5–4.5
12.	Scales around caudal peduncle	9–11

In table 3, sample number, range and mean value of both total length and weight for male, female and both sexes are presented. Females were consistently larger and heavier than males, both in mean length and weight, indicating a clear sexual difference in growth parameters of *L. coubie*.

Table 3: Total length and weight of male, female and combined sexes of *L. coubie* collected from Esa-Odo water reservoir

Sex	N	T. length Min	T. length Max	T. length Mean ± SE	Weight (g) Min	Weight (g) Max	Weight(g) Mean ± SE
Male	65	12.5	20.3	15.99 ± 0.62	14.0	56.2	31.69 ± 3.31
Female	70	13.9	21.6	17.95 ± 0.50	18.6	67.2	42.22 ± 3.03
Combined sexes	135	12.5	21.6	17.12 ± 0.42	14.0	62.7	37.75 ± 2.39

In Table 4, *L. coubie* from Esa-Odo Reservoir exhibited positive allometric growth, with females (0.91) reaching higher growth coefficients (b) than males (0.92), while males (0.75) showed marginally better condition factors compared to the females (0.71). The b value for male, female and both sexes are greater than 3, showing a positive allometric growth of the fish, but the condition factors in all are lesser than 1. Regression analysis using Microsoft Excel indicated a significant relationship between male (0.92), female (0.91) and combined sexes (0.92) length-weight relationship (Table 4).

Table 4: Sample size, length-weight relationship condition factor of *L. coubie* collected from Esa-Odo Water Reservoir

Sex	N	a	b	R^2	R	Growth	K Mean ± SE
Male	65	- 46.75	4.90	0.85	0.92	Positive	0.75 ± 0.01
Female	70	- 55.78	5.46	0.83	0.91	Positive	0.71 ± 0.02
Combined Sexes	135	- 51.93	5.24	0.86	0.92	Positive	0.72 ± 0.01

All other morphological characteristics for both sexes showed positive correlation to the total length (Table 5), with standard length having the highest (0.99) and pelvic fin length the least in relationship (R= 0.53). The relationship between total length and other morphometric characteristics of *L. coubie* revealed that most traits were significantly and positively correlated with total length (R values > 0.85), except for eye diameter (R = 0.74) and pelvic fin length (R = 0.53). Among the morphometric traits, standard length (R = 0.99), body depth (R = 0.97), pre-dorsal length (R = 0.97), and pre-pelvic length (R =

0.95) showed the strongest correlations with total length, making them the most reliable indicators. Conversely, eye diameter (R = 0.74) and pelvic fin length (R = 0.53) contributed the least to length prediction. The table also present the mean value of the characteristics examined and the regression equation.

Table 5: **Relationship between the total length and other morphometric characteristics of *L. coubie* of the combined sexes**

S/N	Morphometric characteristic (cm)	Mean ± SE (cm)	R^2	Correlation Coefficient R	Regression equation
1.	Weight	37.75 ± 2.39	0.86	0.92	Y = 5.2383x - 51.934
2.	Standard length	13.71 ± 0.35	0.99	0.99	Y = 0.8272x - 0.4513
3.	Fock length	4.28 ± 0.08	0.62	0.79	Y = 0.1544x + 1.644
4.	Pelvic fin length	2.56 ± 0.05	0.29	0.53	Y = 0.0679x + 1.40
5.	Pectoral fin length	2.80 ± 0.05	0.85	0.92	Y = 0.1162x + 0.8173
6.	Caudal fin length	4.07 ± 0.10	0.85	0.92	Y = 0.2232x + 0.2544
7.	Pre-dorsal length	5.66 ± 0.14	0.96	0.97	Y = 0.3383x – 0.1318
8.	Pre-anal length	11.17 ± 0.26	0.82	0.90	Y = 0.5612x + 1.5649
9.	Pre-pectoral length	2.98 ± 0.07	0.89	0.94	Y = 0.1622x + 0.2053
10.	Pre-pelvic length	6.93 ± 0.16	0.92	0.95	Y = 0.3713x + 0.5799
11.	Length of dorsal fin base	2.6 ± 0.07	0.91	0.95	Y = 0.1726x - 0.3557
12.	Length of anal fin base	1.00 ± 0.03	0.73	0.85	Y = 0.0682x - 0.1579
13.	Dorsal fin length	4.24 ± 0.16	0.72	0.84	Y = 0.3322x - 1.4387
14.	Length of caudal peduncle	1.80 ± 0.06	0.73	0.85	Y = 0.1324x - 0.464
15.	Body depth	3.33 ± 0.09	0.94	0.97	Y = 0.226x - 0.5305
16.	Snout length	1.31 ± 0.03	0.81	0.90	Y = 0.0706x + 0.1059
17.	Eye diameter	0.59 ± 0.01	0.56	0.74	Y = 0.0203x + 0.2466
18.	Head length	3.11 ± 0.08	0.84	0.92	Y = 0.1734x + 0.1469
19.	Depth of caudal peduncle	1.86 ± 0.05	0.76	0.87	Y = 0.1065x + 0.0406

Discussion

This study has reported a fin formular D11, A6-7, P 12-15 and V8-9 for *L. coubie* and other meristic traits such as scale on lateral line (33–36), scale below lateral line (2.5–4.5), scales below lateral line (2.5–4.5) and scale around caudal peduncle (9–11), although there is paucity of information about the meristic count of *L. coubie*, this report however varied from the report on another member of the same genus *Labeo rohita* although with some common features. Kamboj and Kamboj (2019) reported D11-14, A7, P17 and V9, scale on lateral line (40–42), scales above lateral line (5–7) and scale below lateral line (5–7). The variation in the two fin formular might be due to the fact that they belong to different species and their common features a product of common genus. This investigation reported 4.90, 5.46 and 5.24 as the b value for male, female, and combined sexes of *L. coubie* describing positive allometric growth for all the fish, these findings are contrary to the observations made by Olufeagba et al. (2016) in which they reported isometric growth (3.0) and negative growth (2.63) in both male and female respectively in *L. coubie*. The differences in the b value could be as a result of differences in the fish population, environmental factors, species and seasonal differences. The result of this study correlates with 'b' value obtained by Ajijola et al. (2022) on *L. coubie*, in their study, positive allometric growth were reported with 'b' value of male (4.03), female (3.52) and combined sexes (3.35). In another study, similar report was documented, Ujjania et al. (2012) reported a positive allometric growth with 'b' value ranging from 3.11 to 4.57 for Indian major carps *labeo rohita*. The mean condition factors for male, female and combined sexes were 0.75 ± 0.01, 0.71 ± 0.02 and 0.72 ± 0.01 from this study signifying that the fish were experiencing suboptimal environmental condition since K < 1. Olufeagba et al. (2016) reported K > 1 in both male (2.25) and female (2.16) of *L.*

coubie, a factor showing that the fish were experiencing suboptimal environmental condition. Ajijola et al. (2022) also reported condition factor K > 1 in male (2.54), female (2.52) and combined sex (2.53). The differences observed could be due to differences in the natural productivity and intensity of fishing activities in the various water bodies coupled with fish strains and environment factors differences. Positive relationship exhibited in the length-weight relationship of male (r = 0.92), female (r = 0.91) and combined sexes (r = 0.92) of this study is in accordance with the outcome of Olufeagba et al. (2016), they reported r = 0.92 for male and r = 0.91 for female of *L. coubie*. This study's result is further supported by Ajijola et al. (2022) who also reported strong positive correlation between length and weight characteristics of *L. coubie* examined for male, female and combined sexes. In this study, the relationship between total length and other morphological characteristics exhibited strong (r = 0.99) to weak (r = 0.53) positive relationship. Although pelvic fin length had the lowest relationship with the total length, this could be due to allometric growth of different parts or ecological factors such as swimming habits, habitat and reproductive behavior. Similar result on total length and other morphological parameters was recorded from a member of the genus *Labeo rohita*, Kamboj and Kamboj (2019) reported strong relationship between total length of *L. rohita* and other morphological parameters which ranged between r = 0.99 and r = 0.94. Morphological and meristic in this study are important for sustainable fisheries management and its knowledge is required for breeding in the case of potential domestication of the fish for aquaculture (King, 2007; Fagbuaro et al. 2019).

Conclusion

This study has made an exposition of the length-weight relation of combined sexes r = 0.92 which is a strong relationship, condition factor K < 1, a condition indicating suboptimal physiological state of fish, morphometric and meristic characteristics of *L. coubie*. The 'b' value for male (4.90), female (5.46) and combined sexes (5.24) shows positive allometric growth in the fish and *L. coubie* has fin formula D11, A6-7, P 12-15 and V8-9. The relationship of total length with other morphometric parameter indicated varying degree of positive relationship. The findings of this study on *L. coubie* can be baseline for its conservation, evolutionary study, sustainable exploitation and management. Regular monitoring is therefore recommended to track changes in condition factor and growth pattern for sustainable management of the species.

Acknowledgements

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Declaration of Interest

Authors of this article declare that there are no known competing financial interests or personal relationships that can affect the report of this study.

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